THE PROBLEM OF CRYSTALLISATION.

An Introduction to Chemical Crystallography. By P. Groth. Authorised translation by Dr. Hugh Marshall, F.R.S. Pp. xii+123. (London: Gurney and Jackson, 1906.) Price 4*s.* net.

IN providing for English-speaking readers a translation of Prof. Groth's "Einleitung in die chemische Krystallographie," Dr. Marshall has performed a task of great utility, the value of which is no doubt enhanced to many in this country by the references to abstracts and papers in the Journal of the Chemical Society added by him. In preparing the translation he has kept closely to the original, but not so slavishly as to mar the literary style.

The question as to the precise nature of the constitution of unorganised matter, including as it does the problem of the phenomenon of crystallisation and the relation between the chemical composition and the crystal structure, has since the time of Lucretius, and even earlier, been the subject of no little speculative thought, much of which has necessarily been abortive because the knowledge derived from experiment was not sufficiently far advanced to act as a check on the correctness of the various theories propounded. The past century has, however, seen a vast increase in the store of facts relating to the characters of mineral substances, and chemists have, particularly in recent years, recognised the importance of determining with precision the crystallographical properties of the salts prepared by them in the laboratory. For many years past Prof. Groth has been engaged in the preparation of a complete digest of the physical properties of all crystallised substances. The first of the four volumes in which that work will appear was reviewed in NATURE of April 4 (vol. lxxv., p. 529). To that colossal work this small volume forms an introduction.

In a remarkably brief compass, and with all his customary lucidity of exposition, Prof. Groth has summarised the state of our knowledge at the time of writing. After a short discussion of the possible varieties of crystal structure, he proceeds to consider the main subject in its various aspects. Polymorphism deals with the various modifications displayed by the same substance, such as, to take the best-known instance, sulphur, and the nature of the transition between them. The next chapter is concerned with morphotropy, or the comparison of the crystal structures of chemically allied substances, such as, for instance, the aromatic compounds. Isomorphism is a particular case of morphotropy, in which the change in composition leaves the structure almost unaltered. The last chapter treats of molecular compounds, which, however, cannot be differentiated from isomorphous mixtures.

So vigorous is the growth of this subject that, even though various alterations have been embodied in the translation which were necessitated by the publication of investigations during the short interval that elapsed between the dates of appearance of the original and the translation, further revision is demanded by still more recent material. Of primary importance is the simple yet fundamental theory of close-packing put forward by Mr. Barlow and Prof. Pope in a paper read before the Chemical Society in November last.

We may commend this introduction to all who are interested in this important subject, and especially to chemists in this country, to whom we hope it may reveal the advantages of a study of crystallography, a branch of science of which they are said to be neglectful.

PHYSICS FROM MANY POINTS OF VIEW.

(1) *First Year's Course in Practical Physics.* By James Sinclair. Pp. viii+124; illustrated. (London: George Bell and Sons, 1906.) Price 1*s.* 6*d.*

(2) *Theoretical and Practical Mechanics and Physics.* By A. H. Mackenzie. Pp. xvi+112; illustrated. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1906.) Price 1*s.*

(3) *Junior Experimental Science.* By W. M. Hooton. Pp. viii+260; illustrated. (Cambridge: University Tutorial Press, Ltd., 1906.) Price 2*s.* 6*d.*

(4) *Text-book of Mechanics.* By Louis A. Martin, jun. Vol. i. Pp. xii+142; with diagrams. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 5*s.* 6*d.* net.

(5) *The Tutorial Physics.* Vol. v. Properties of Matter. By C. J. L. Wagstaff. Pp. iv+251; illustrated. (Cambridge: University Tutorial Press, Ltd., 1906.) Price 3*s.* 6*d.*

(6) *Practical Physics.* By W. R. Bower and J. Satterly. Pp. xi+399; illustrated. (Cambridge: University Tutorial Press, Ltd., 1906.) Price 4*s.* 6*d.*

(7) *The School Magnetism and Electricity; a Treatise for Use in Secondary Schools and Technical Colleges: based on Potential and Potential-gradient.* By Dr. R. H. Jude. Pp. vi+403; illustrated. (Cambridge: University Tutorial Press, Ltd., 1906.) Price 3*s.* 6*d.*

(8) *Mechanics Problems for Engineering Students.* By Frank B. Sanborn. Second edition, revised and enlarged. Pp. viii+194; illustrated. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 6*s.* 6*d.* net.

(9) *A First Course in Physics.* By Dr. R. A. Millikan and Dr. H. G. Gale. Pp. viii+488; with illustrations. (Boston, New York, Chicago, and London: Ginn and Co., n.d.) Price 5*s.* 6*d.*

ANYONE who thinks that the existing supply of text-books in mechanics and physics is quite sufficient is neglecting to make an adequate estimate of the extremely varied conditions under which teachers and pupils work. There was never a time when so much teaching was being done as now. Elementary school, high school, public school, technical school and college, each is developing on different lines, with the result that each feels the need of a text-book written specially to suit its work. Besides these, there is the cramming school, the main object of which is to get a man "through" an examination; this also has its special aims and needs, and seeks to satisfy them. Those of us who are ceasing to be young fared very differently in our day

from the modern student. A few leading text-books we had from which to select; after reading these we were encouraged at once to study the more simple of original papers and treatises. In this way we were led early to view science in the making, and ever since we have valued the independent spirit which this mode of training infused into us. Granting the increased facilities for absorption (it is amazing what some of our junior students "know"), it yet remains to be seen whether the present mode of boiling down science into a sort of intellectual pemmican will turn out better scientific men. Meanwhile, the flow of text-books continues, each written to meet some want. The above are some that we have received.

(1) In this first course in practical physics an attempt is made to provide for pupils in day schools, evening schools, and pupil teachers' classes a course which is not too difficult for young students, but which contains all that is really essential. The description of the experiments is not surrounded by any theory, the author's opinion being that this should be given by the teacher—at any rate in the first year. The course is a very simple one, consisting of exercises in the measurement of length, area, volume, mass, relative density, pressure of air, and of a few experiments in heat. The instructions given seem to be very clear in the main, and the order of experiment is quite logical.

(2) The text-book by Mr. Mackenzie is intended for artisans in evening schools. These belong to a class of student which has not been sufficiently catered for up to the present. A volume like this is an effort to provide something suitable for preparing them to benefit more fully from the instruction given them in the principles underlying their trades.

The course laid down is wholly experimental.

"Although instructions on the carrying out of experiments are given in detail, the students are not told as a rule what they are expected to see or what conclusions they should draw."

No previous experience of laboratory work is expected. The range covered is the same as in No. 1. We recommend this volume as a very suitable introduction to the rudiments of the subject.

(3) "This book has been written in order to supply a want," viz. a work containing approximately all that is required by the syllabuses in experimental science set for the Oxford and Cambridge junior local and Central Welsh Board junior examinations. It is primarily meant to help the teacher by providing the material required for revision. The subject-matter includes hydrostatics, mechanics, heat, and chemistry. Each experiment is prefaced by a short theoretical account which will add value to the book, and each chapter ends with a set of questions. There is not much room for originality in such a volume—the conditions laid down in producing it tend to preclude originality. The descriptions, so far as they go, appear to be clear, and provided a student actually does the described experiments are probably sufficient. We regret to see the phrase "whole pressure" alluded to in a modern text-book; still more do we regret to see it defined as the total force tending to deform a body.

(4) Mr. Martin's "Text-book of Mechanics" deals only with statics; the kinematics and kinetics are to follow in a second volume. For such an elementary book sufficient care is not always exercised in connection with fundamental illustrations. The necessity of a strong push to displace appreciably a large ball of iron hung up by a string indicates its great *weight*, and not its great mass. The difficulty of displacing it *quickly* depends on its mass. It is not usually true to say that "two bodies of equal mass moving with equal and opposite velocities will on impact (collision) come to rest." Even two equal lead balls will not behave in this way. Force is defined in the introduction as rate of change of momentum; no attempt is made to connect this definition with the use of the word force in the body of the book. Putting aside, however, this incompleteness of logical treatment, the volume may be considered a useful summary of elementary rules regulating the equilibrium of bodies. The last third of the book consists of chapters on graphical statics with applications to stresses in members of framed structures. These chapters will be found to be useful in teaching technical students, for whom they are primarily intended. There is no calculus employed, although it will be used extensively in the companion volume, which is nearly ready for the press.

(5) "Properties of Matter," by Mr. Wagstaff, is a somewhat more ambitious work, since it is intended to include all that is usually required for a pass degree; it therefore deserves a stricter examination. We must point out that Borda's metre has long been obsolete; the same remark applies to Borda's kilogram. The work of the Bureau International seems to be little known to writers of text-books. The author deserves credit for attempting to introduce vitality into his subject by outlining various attempts to "explain" matter. However, is not Osborne Reynolds's interesting granular theory now discredited? Also, is there not some doubt about the possibility of explaining all mass as being electromagnetic? We think that the selection of problems has been very well made, and the treatment is very clear. A proof is given of most of the theorems stated, and this is usually sufficient for those who intend to proceed only to a pass degree. Suggestions, of course, might be offered in many ways. The experiment on a stretching wire is most easily made with a wire of copper. With a thin wire the whole course of the extension up to the breaking point can be obtained with small loads, and the amount of permanent extension is much more considerable than with steel. We think that some idea of the nature and character of rolling friction should be included. Were this done, an explanation could also be given of the incompleteness of the working out of the problem of the disc rolling down an inclined plane. The solution given (the usual one, by the way) involves perpetual motion of the disc when once started on a horizontal plane, for its acceleration would be zero. The fact is that if the friction be represented by a single force it cannot be represented

at the same time as acting at the point of contact between the disc and the surface.

(6) In the "Practical Physics" of Messrs. Bower and Satterly we have a course intended for matriculated students. No previous knowledge of experimental physics is assumed, however, and hence the handbook is a complete elementary manual of the subject. Great pains have evidently been taken to secure efficiency, and the result is a text-book which merits great praise. Both the writers have had considerable experience in practical work, and, moreover, have the ability to impart the results of this experience to others. The volume is profusely illustrated with sketches, which will prove of great use to teachers who are obliged to make their own apparatus. Most of the experiments are intended to be performed in a properly equipped laboratory; certain of them are designed to be performed at home. The latter have been arranged so as to keep the cost of performance low, but at the same time merely trifling experiments have been avoided. These experiments form part of the complete course, and are meant to be done in a laboratory, if not at home.

(7) In spite of the considerable merit of the preceding manuals, we turn from them to Dr. Jude's elementary treatise and peruse it with some sense of exhilaration. It is only a school book, containing "all of the subject that is required for the London University Matriculation," though not written to the syllabus of any examination; but from first to last there is an originality of treatment which makes it interesting reading even to one who is *blasé* in the reading of text-books. Our only doubt is whether it is not too thorough for such examinations as that named; a wise teacher will know, however, how to benefit by it himself, and at the same time to temper it to the more junior boys without sacrificing the thoroughness. According to its subtitle, it is based on "potential and potential-gradient," notions which even university students sometimes find it hard to grasp. The fallacy of the old theory of "free and bound" charges is exposed, and this exposure is made much more effective than is customary. It is shown that when a conductor is under electric induction, the amount of electricity which runs out of the conductor on earthing is not in general equal to that which resided beyond the neutral line before the earth connection was made. In the case of a sphere under the action of a point-charge placed at a distance of four times the radius from the centre, the so-called "bound" charge is less than one-fifth of the induced charge when the sphere is earthed. A matriculation pupil will not understand the mathematical quotations in respect to this point, but these quotations will serve to keep many a teacher on the right path. This example indicates the thoroughness characteristic of the volume. The diagrams are numerous, and, in general, are good, but it is certainly with regret, and also with some surprise, that we see certain familiar lines-of-force diagrams doing duty once more. A moment's reflection should persuade anyone that a diaper pattern between two north poles (p. 206) hardly does justice to the lines as pourtrayed by iron-filings, imperfect though these are. Still less does it do justice to the true lines of force between two such poles. The figure for two opposite poles (Fig. 94) should also be replaced by a much more satisfactory one. We do not wish to conclude the notice of the book by an adverse criticism, however slight. It has given us great pleasure to read through it, and we hope that this pleasure will be felt by very many more.

(8) The collection of mechanics problems made by Mr. Sanborn is a second edition of a book prepared for engineering students. The aim has been to present many practical problems, together with brief definitions and solutions of typical problems, to help the student to follow George Stephenson's advice to his son Robert: Learn for yourself, think for yourself, make yourself master of principles. It is illustrated with process-work cuts in the new manner, presumably with the object of adding interest to a mere collection of problems. Whenever these cuts illustrate a definite point, their inclusion acquires a real value. In some cases the moral is somewhat hazy. The frontispiece of an engine belching black smoke on an up-grade on the Pennsylvania Railroad at Tyrone seems somewhat superfluous, especially as the camera, having seized the wrong perspective, has given the lines a down-grade rather than an up-grade appearance. In other cases, where, for example, it is a dipper dredge which is depicted in full working order, the picture is necessary to the proper understanding of the problem on the opposite page. There is a novelty about the choice of problems which we very much appreciate. The utility of the book would be enhanced if more of these problems were worked out in detail. With regard to provision of answers, a middle ground has been taken in giving them to about half the questions. The answer to a problem is not the principal thing from the standpoint of education, though it of course becomes very important when it forms the basis of a monetary transfer. The one feature of the book which we fail completely to understand is the order in which the questions are arranged—work, force, motion. Is it possible that it is intended that the exercises should be performed backwards?

(9) "A First Course of Physics," by Drs. Millikan and Gale, "has grown out of the actual needs of the elementary work in Physics in the University of Chicago, particularly in the University High School." The aim has been to give "a simple and immediate presentation, in language which the student already understands, of the hows and whys of the physical world in which he lives." It must not be understood from this quotation that we have here merely a compilation for the amateur reader; the volume is a genuine text-book for schools. We think that in the choice of matter and in its treatment the authors have been successful. Not the least valuable feature is the large number of excellent portraits of physicists, old and new, from Aristotle to Galileo, Maxwell, and J. J. Thomson; these will help to stimulate the budding genius. In the section on image formation the method of wave-curvature has been adopted. We agree that in the elementary treatment of images there is advantage in this method; at the same time,

we do not see in what respect the representation of waves by their wave-fronts is associated with less fiction than what the authors refer to as "the time-honoured fiction of rays." Whether the wave is represented by its front or its normal is a question merely of convenience or lucidity. The fiction which affects both equally consists in regarding the wave as a simple spherical one, and when the question is the higher one of the deviation from sphericity, we think the advantage lies all on the side of the method of rays. We conclude by wishing this volume all success; it deserves to be widely read.

THE PRINCE OF ENTOMOLOGY.

Les Débuts d'un Savant Naturaliste. Le Prince de l'Entomologie. Pierre-André Latreille à Brive de 1762 à 1798. By Louis de Nussac. Pp. vii+264. (Paris: G. Steinheil, 1906.) Price 5 francs.

THE subject of this memoir was the natural son of Baron d'Escagnac, and some doubt exists as to the exact date and place of his birth; his biographers, however, are agreed in giving the former as 1762, and Brive, in the department of Corrèze, as the place where he first saw the light of day. He was educated at Brive and at Paris, took orders in 1781, and eight years later became a fully ordained priest. The Revolution altered the ecclesiastical future of Latreille, for in 1793 he was arrested on the charge of neglecting to take the oath of allegiance to the new Government, was thrown into prison, and sentenced to exile in Cayenne in company with other recalcitrant priests.

Latreille was saved from this fate by the influence of friends and by a fortunate accident, the story of which is of considerable interest. On the wall of his cell, which he shared with an invalid prisoner, Latreille, who was already an expert entomologist, found a specimen of a beetle that he recognised as new to science; the surgeon attending the invalid observed Latreille's excitement, and on discovering the cause of it asked if he might give the specimen to a scientific friend, M. Bory. Next day the surgeon brought back word that M. Bory was unable to identify the new beetle, and Latreille, perceiving that he was dealing with a brother entomologist, sent him the message:—"Vous lui direz que je suis l'Abbé Latreille, qui va aller mourir à la Guyane avant d'avoir publié son 'Examen des Genres de Fabricius.'" Steps were immediately taken to free the captive, and he was literally snatched from the ship bearing the exiles to Cayenne; the ship subsequently foundered off the French coast, and all hands were lost. Latreille, in his classic work on insects and crustaceans, describes the insect that was the means of his salvation as *Necrobia ruficollis*, and details the circumstances of its discovery; in his "Genera crustaceorum et insectorum" he apostrophises it as "Insectum mihi carissimum," and a representation of it is carved on the bust of the great entomologist in the museum at Brive with the inscription "Necrobia ruficollis Latreillii salus anno MDCCXCIII.

After these adventures Latreille returned to Brive, and tranquilly resumed his entomological studies. The end of the eighteenth century in France was marked by the immense stimulus given to the scientific study of agriculture; societies for the encouragement and advancement of agriculture sprang up everywhere, and met with official sanction and help. Experiments on the cultivation of all sorts of crops were carried out, new agricultural machines were invented and tested, efforts were made to combat insect pests, and the methods of other countries were studied. In fact, France more than a century ago had arrived at a stage in agricultural progress which the modern Englishman may well envy. To-day an industrious peasantry, firmly rooted to the soil, is the prop and mainstay of France, and who can doubt that their existence is largely due to the work of those early agricultural societies, called into being themselves by the revulsion of feeling against a tyrannical and effete landed aristocracy? The cry of "Back to the Land" is only heard in those countries where the needs of agriculture are regarded by legislators with languid indifference.

In a milieu of eager and scientific inquiry a man like Latreille was bound to make his mark; he was appointed professor of natural history at Brive, and in 1798 was elected a member of the Institut National des Sciences et des Arts of France. During these years he was in active correspondence with Fabricius, to whom he owes his title of *Princeps Entomologiae*, with Olivier, Bosc d'Antic, and other entomologists of the day, and he was personally known to the Paris zoologists, the great Cuvier, Duméril, Daubenton, and Lacépède. Several of his letters are quoted by M. de Nussac, and these alone show, even if we had not his published works to convince us, that Latreille possessed the true Frenchman's power of generalisation and ability to seize on characters of prime importance for systems of classification. In 1796 Latreille published at Brive his first great work, "Précis des Caractères génériques des Insectes," which earned for him the plaudits of the entomological world of the day; it was followed by "Essai sur l'Histoire des Fourmis de la France," and shortly afterwards Latreille migrated to Paris to take up a post in the Natural History Museum. There his biographer leaves him, but promises a second volume on his subsequent career; M. de Nussac will find it difficult to write a more interesting volume than his first. R. S.

OUR BOOK SHELF.

The Steam Turbine as Applied to Marine Purposes. By Prof. J. H. Biles. Pp. vii+126. (London: Charles Griffin and Co., Ltd., 1906.) Price 6s. net.

PROF. BILES delivered the Keith lectures before the Royal Scottish Society of Arts in Edinburgh during the spring of 1906, and as only a condensed summary of the lectures was published by the society in its monthly journal, while many requests were made to the lecturer for complete copies of the lectures, he decided to publish them in book form.